Public Health Service Publication No. 58

WATER POLLUTION CONTROL

Excerpts from

"A Water Policy for the American People"

THE REPORT OF THE
PRESIDENT'S WATER RESOURCES
POLICY COMMISSION
1950

FEDERAL SECURITY AGENCY
Public Health Service
Division of Water Pollution Control

January 1951

FOREWORD

During the past century the water resources of this country have been severely damaged by pollution. With the growth of our cities and towns, and the development of industries, sewage and wastes of many kinds have been poured into our streams in increasing quantities. The quality of the water has consequently gone down until in many places it is unfit for any use except as a vehicle to carry the sewage away.

Clean water is one of the most important elements of a sanitary environment. A sanitary environment is the foundation on which a sound public health structure must stand. Water pollution control is therefore a matter of utmost concern to all of us.

Clean water is important to all aspects of human living--to health, sanitation, industrial and agricultural production, and recreation. It is also important to the conservation of other natural resources, such as fish and wildlife in general.

In its report entitled "A Water Policy for the American People," issued in December 1950, the President's Water Resources Policy Commission discussed water pollution from these different standpoints. Selected comments of this nature are reproduced here, in addition to the chapter of the report devoted to "Pollution Control." Because of the importance of pollution prevention and abatement to the safeguarding of water supplies, the chapter of the report on "Domestic and Industrial Water Supply" is also reproduced.

Leonard A. Scheele

Surgeon General

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Reproduced from the Report of the President's Water Resources Policy Commission, 1950, "A Water Policy for the American People"; pages 15, 17, 48, 51, 57, 101, 175-195, 248, 252, 261, 268, and 271.

Public Health Service Publication No. 58

Chapter 13

Pollution Control

THERE WAS A TIME not so long ago when this land of ours was so wide and new and lightly settled that questions of water sanitation could be left to the individual or to the family group; and the consequences could be largely ignored. Where populations and habitations first formed in sizeable clusters in our East, however, trouble soon started; and agitation that reflected a previous like unease in Old World cities, dwelling in fear of plague, arose. As settlement proceeded and population mounted, pollution began to take its toll in our West too; and by the turn of the present century public demand for clean water had become Nation-wide. More than 100 bills dealing with the problem of pollution have been introduced in Congress during the past 50 years, culminating in the passage of the Water Pollution Control Act of 1948.

As the difficulty of solving the problem is realized, pollution has aroused almost as much concern as another item of news today—our water shortage. The two are accomplices in retarding progress. No informed person can fail to recognize the direct relation between water pollution and water scarcity, for polluted water is almost as bad as no water at all, and where it endangers life or health, momentarily worse. Our cities and industrial plants today discharge into our waterways polluting materials equivalent to the raw sewage from 150 million people.

The Public Health Service recently reviewed pollution conditions in 11 major river valleys representative of the country as a whole. They were the Connecticut, Delaware, Potomac, Ohio, Alabama-Coosa, Arkansas-White, Rio Grande, Missouri, Colorado, Central Valley of California, and the Columbia.

The review proved conclusively that (1) even though not all streams are polluted, our major streams are gravely affected and the problem is Nation-wide, and (2) pollution is a factor that already affects or eventually will affect all water resources development, whether it be for flood control, irrigation, hydroelectric power, municipal and industrial use, or recreation.

These 11 field surveys covered 4,409 municipalities and 3,413 industrial plants. Of the cities studied, 1,912, or 43 percent, were discharging raw untreated waste into nearby water. Of the 3,413 factories, 1,967, or 57 percent, were discharging untreated waste. It was further found that 800 of the treatment works now in operation throughout the country are overloaded or inadequate.

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tories discharge their wastes wholly untreated.

Some Case Histories

The main stems of many of our major rivers, acting as trunks of their tributary streams and rivers, suffer under a heavy load of pollution.

Many of our cities are compelled to use as a source of water supply a river flow that is heavily burdened with sewage and industrial waste.

Consider, for example, the situation at Cincinnati, Ohio. The people of this city depend upon the Ohio River for their water supply. At low flow this Ohio River water is half-way made up of water already used, and perhaps reused, by cities and industries farther up the river in that heavily populated and industrialized valley.

The Ohio is one of the most polluted streams in the country. Into it pour the mine drainage and sulfuric acids, and industrial and domestic waste of the Monongahela, the Allegheny, the Mahoning, and other tributaries. The resulting pollution is so serious as to discourage further industrial expansion, and factories in need of water for processing or cooling purposes are tending to locate elsewhere. In this grossly polluted region the water purification work is under terrific strain to keep a supply of usable water up to current requirements. The crisis here is real.

In New England the waters of the Merrimack have been so fouled for many years by sewage and factory discharges that some of the commercial clammers at its mouth must rinse the clams in salt water or possibly in chlorinated water before selling them.

Into the Connecticut River, more than 100 cities and 300 industries pour sulphite waste, acids, dyes, cyanides, ink, and other toxic materials, along with untreated and treated sewage. In sum, this waste represents the equivalent of the raw sewage from more than 1,600,000 persons.

So again, at many points along the rivers of our Middle Atlantic area—the Hudson, the Delaware, the Potomac, and others—pollution is proceeding faster than measures of rectification. On the Mohawk below Utica, for example, then on the Hudson below Albany, and finally, of course, at New York City itself, there is trouble. The Commissioner of Health of New York City has stated: "If raw sewage continues to be discharged into the waters around New York City, the pollution of these beaches where bathing is now permitted will increase proportionately, and the danger of disease outbreaks will be so great that in the public interest, it will be necessary to prohibit bathing."

Bathing in the polluted waters around Trenton, Philadelphia, and Wilmington on the Delaware has become almost out of the question, and the same is true of the "beautiful" Potomac as it flows past our Nation's capital.

Southern rivers are not exempted from this plague of pollution. Some of them, such as the three tributaries flowing into the Black Warrior River in Alabama, are exempt from pollution control. Local law permits any amount of pickle liquor and all other waste from the steel mills to be dumped untreated into these streams.

In Florida, one of the vacation areas of the country, the St. Johns River at Jacksonville shows the effects of the citrus and paper pulp wastes poured into its tributaries.

Citrus wastes make an open sewer 30 miles long on the Rio Grande near Brownsville, Tex. Salt brine from oil wells poisons the Verdigris, and the great Missouri from northern Nebraska on down to St. Louis and the Mississippi suffers repeated shocks of industrial and municipal discharge that overload the water purification facilities of cities along the course.

The South Platte River below Denver, Colo., runs from a third to two-thirds sewage water during low flows; this grossly polluted water flows on down for use later in irrigating thousands of acres of farming land.

Nor are the rivers of our newer West all fresh and clean. The waters of the Sacramento in northern California are destined for broad irrigation use; yet they are being filled with cannery and other wastes. Even smaller rivers in California are feeling the impact of accelerated pollution. In 1948 the State's attorney felt obliged to bring suit against the city of Modesto and 13 food product and canning companies for destroying the salmon of the Tuolumne.

In the Pacific Northwest, a still relatively little developed region of virgin forests and spectacular mountain scenery, the Willamette River pours water polluted with pulp and paper wastes into the Columbia near Portland, Oreg., and Puget Sound has tidal waters that swarm with corruption gathered from the coastal cities of Washing-

ton State. Once the processes of pollution get under way, they increase in pace, and even a new and virginal region may soon be sullied.

Progress in Control

So much for the dark side of the national pollution picture. It is important to note that State and municipal authorities are almost universally aware of this menace to our economy, and many of them are making headway in the fight against it.

In the New York City area, the record shows distinct progress in combating the increasing amounts of sewage being dumped into New York Bay. If this progress had not taken place, some of the area's popular bathing beaches and recreational places would already be condemned, instead of merely being faced with the threat of such action. By interstate compact, and through the Interstate Sanitation Commission formed for the purpose, the States of New York, New Jersey, and Connecticut have joined forces in trying to solve the problem. The commission has issued more than 80 orders during the past 13 years for local authorities to "clean up." The Interstate Commission is following a definite program. By 1953, 75 percent of the area's sewage flow is expected to receive treatment; and by 1959, all sewage discharge in the area should be receiving purification treatment before discharge into the waters of the bay. The beaches threatened with closure may remain open despite population increases, if the Commission's program is adhered to.

Another notable example of successful State action is found on the polluted St. Joseph River, which flows from the southeast corner of Michigan across northern Indiana and back into Michigan before flowing into Lake Michigan. This presents an interstate problem in pollution control. When the Michigan water pollution control agency ordered the city of Niles, Mich., to treat its raw sewage before discharge into the St. Joseph River, the city indignantly pointed to the filth already contaminating the river before it reached Niles, dumped into it by the Indiana cities of Elkhart, Mishawaka, and South Bend higher up the river. Why spend money on sewage treatment when the river would still be dirtied by these cities above? The Michigan Supreme Court upheld the State Water Pollution Control order, however, and Niles was compelled to build a treatment plant. The matter did not rest there. At the request of the State of Michigan, the State of Indiana and its Stream Pollution Control Board prevailed upon the three offending cities to build sewage treatment plants. Their plants are scheduled for completion in the summer of 1951. Pollution in this section of the St. Joseph River will then be substantially abated.

The Illinois River also offers instance of successful local endeavor. In the Peoria-Pekin area, municipal sewage and brewery, distillery, and yeast plant waste was fouling its water for 100 miles, creating nuisance conditions during low flow periods and damaging commercial fishing. The Illinois Sanitary Water Board succeeded in persuading Peoria, East Peoria, and Pekin to construct treatment facilities. Then the board worked with the industries in all three cities. In 5 years the industries spent several million dollars on corrective works which now remove the bulk of the industrial waste formerly being discharged into that part of the river. Hampton Roads, Va., an important naval center and one of America's finest harbors, offers another example of progress in pollution abatement due to local effort. The entire northern section and other portions of this oyster ground were closed in 1926 because of dangerous disease conditions due to sewage from Norfolk, Portsmouth, Newport News, Hampton, Phoebus, and Old Point Comfort, all on the bay. But the Hampton Roads Sanitation Commission's persistence since 1938 has brought about the construction of four sewage treatment plants, and last year a public health service bacterial survey reported a "very significant improvement in water quality." The improvement has been so definite that 1,500 acres of the condemned area have been opened to shellfishing once more, and still further relaxation of restrictions is under consideration.

A Serious Waste

The removal of wastes is a proper and necessary function of water, both in the state of nature and amid the increasing complexities of a modern civilization. It does not follow, however, that the removal of wastes need, through neglect or mismanagement, befoul our streams and rivers and render them ugly, barren, dangerous, and useless. We cannot afford such waste. Polluted water impedes economic and social progress.

Polluted water threatens life and health, blocks the expansion of industry, and increases the cost of its products. It robs us of recreation and vacation areas which once lost can never again be re-created, destroys our sports fishing, swimming, and boating. It forces us to spend large sums of money for elaborate water-supply systems reaching hundreds of miles into the mountains, and for expensive water purification works. It impairs the value of our property, poisons our shellfish food, kills our fish, birds and other wild-life, damages our boats, ships, buoys, piers, and waterfront structures.

Our cities, our industries, and our farm and grazing land are the three major sources of pollution. The sewers in cities discharge domestic waste, such as toilet flushings, bath and dishwater, restaurant and laundry washings, hospital and hotel refuse, and all kinds of other unwanted matter. Industrial wastes consist of acids, oil, chemicals, grease, animal, and vegetable materials—some poisonous, some noxious, and still others merely noisome and offensive to the eye and nostril.

Agricultural pollution is made up of drainage from livestock feed lots, dairy barns, pigpens, manure heaps, corncob piles, and other farm refuse. Poison sprays and dips may likewise contaminate streams.

Water so laden with wastes may become unfit not only for drinking, cooking, washing, factory use, farm use, swimming, boating, fishing, or irrigation, but unfit even to live near and look at. It becomes degraded to one principal use, that of a waste carrier. That is why so many of our rivers today are sometimes referred to bitterly as open sewers.

Effect of Urban and Industrial Growth

How did all this come about? It is first to be noted that pollution, quantitatively speaking, is directly proportional to population and industrialization. A hundred years ago this country was predominantly rural and agrarian with relatively few cities. Today we have a relatively highly industrialized economy with more than 17,000 incorporated communities, more than 200 of which have a population in excess of 50,000. Three-fifths of our people now dwell in towns and cities. Nearly half of us are in 150 cities, occupying less than 2 percent of the land area.

Great spurts of industrial development have accompanied this growth and concentration of population.

Well before 1900, pollution had begun to demand attention in the East. In certain areas there the water had to be purified to make it fit to drink. The first filter plant in the United States was built in Poughkeepsie, N. Y., on the Hudson River, in 1875. By 1900 other cities had installed individual waterworks capable of supplying two million people—3 percent of the population—with purified water. From a health standpoint this was not enough. In 1900 more than 23,000 people died of typhoid fever, a waterborne disease. Alert to the dangers of impure water, sanitary engineers moved to develop purification; and in 16 years the number of people served by public waterworks increased tenfold, to a total of 20 million or nearly one-fifth of the population. Even this was not enough; in 1916, typhoid still claimed 13,000 lives.

Today, some 16,000 waterworks supplying nearly 100 million people—two-thirds of the population of the United States—are playing a part in virtually eliminating typhoid.

During this same period our towns and cities were building sewer lines to dispose of their waste—not as fast as waterworks perhaps, but in substantial number. The object was the same—to avoid disease, to eliminate the dangers of epidemics. The first sewer systems were built in

the 1880's. Today we have 9,000 such systems serving 75 million people.

Sewer construction far outran provision for sewage treatment. The historical function of sewage treatment from the first has been to extract the solid matter or sludge from the sewage and to discharge the remaining effluent in the form of a relatively disease- and nuisance-free waste, usually into the nearest water.

Of the 9,000 sewer systems in operation today (compared with 16,000 waterworks) only 6,000 flow into a treatment plant. Nearly two-thirds of our population is served with a public water supply, and one-half with sewage collection facilities, but only a third of the population is served with sewage-treatment plants.

In the pollution abatement efforts to date the emphasis has been placed on cure at the intake of urban water systems rather than on prevention at the outlet. Public health workers have long recognized that this was inadequate to meet the problem.

Some years ago a U. S. Public Health Service Assistant Surgeon General described the progress in city sewer construction since 1880 as "a great sanitary achievement" but added soberly: "The direct consequence has been greatly to increase the pollution of watercourses; for the simplest and most obvious means of disposing of sewage is to discharge it directly into a convenient body of surface water, and this has been common practice."

Nor was this the only weakness in our pollution policy in past days. Practically no thought was given to the possible use of the waste material, much less of the water itself. There was no conception of the large conservation possibilities in all sewer works, that transform an objectionable, unwanted waste material into valuable organic matter and usable water. The only desire was to get rid of the sewage and, if the river or other water dilution failed to make the waste harmless, the dangerous problem floated down to the community below. There were sporadic protests, true, but the practice was not only prevalent but almost universally accepted. Today, the increasing use of modern kitchen equipment like garbage disposals throws an ever greater burden on the waste-carrying capacity of our rivers—and flushes away an ever larger quantity of organic material and minerals that should be returned to the soil.

Industrial Wastes

The attitude of factories toward the disposal of waste was at first identical with that of the cities. But before long, industry discovered that in some cases it was possible to recover part of its waste and convert it into valuable byproducts. More and more industrial managers have become alert to this opportunity. Nevertheless, and despite the sensitivity of industry to public good will, the industrial waste pollution problem today is greater and more crucial than the problem of our domestic sewage.

Industrial waste is often as complex as industrial processes themselves; we do not know how to treat certain wastes, especially in the chemical industry, or how to eliminate mine drainage acid without great expense. Furthermore, technological progress continually develops new materials—such as coal-tar derivatives, cellulose compounds, and phenolic resins—producing new wastes whose effects on the water and whose treatment requirements are not yet known.

Some industrial wastes are much more deleterious than sewage. Aside from poisonous and corrosive characteristics—found in lead, arsenic, chromium, copper, and cyanide concentrations, sulfuric and other acids, and phenols (carbolic acid)—certain wastes destroy more of the normal oxygen content required by plant and animal life in the water than human wastes. The oxygen demand (or amount of oxygen required for the decomposition) of waste is one of the yardsticks for determining pollution in a lake or stream. Except for poisonous or corrosive qualities, this yardstick is the standard measurement for the pollutional effect of industrial waste compared with domestic waste. The oxygen demand for decomposing or "stabilizing" packinghouse waste is 10 times higher than sewage, while tannery waste solids require 2½ times more.

Sedimentation

Another major pollutant of our streams is sediment. Natural land erosion has been aggravated tremendously by bad farming and other kinds of faulty land usage.

Sediment combined with other wastes produced by civilization can change a normal life-giving stream or lake into sick water. Suspended matter cuts down the light entering the water on which plants depend for photosynthesis and stimulation of growth and the manufacture of oxygen. It affects the nature of all the plants and animals living in or on the water which in turn affects those that live upon them. Mud and sludge blanket spawning beds and destroy fish and fish-food organisms such as the larvae of May flies, dragonflies, damsel flies, stone flies, hellgrammites, and water animals such as shrimp, crayfish, clams, oysters, snails, and water beetles. Green algae and diatoms are replaced by unhealthy fungus growth and tubifex worms. Slime and aquatic vermin take over, and the water becomes unfit for fish, waterfowl, wild birds, and animals. The entire ecological balance or natural beneficial interrelationship is upset.

The loss of the healthy relationship between life and its environment is only one direct consequence of sediment and other pollution. All other benefits arising from the development of water resources are also affected.

In respect to flood control, deposits of sediment and other pollutive substances raise streambeds, divert flows, and impair the usefulness of works constructed to reduce flood damage.

In domestic, municipal, and industrial water supply, pollution not only reduces the usefulness of reservoirs and other costly construction but may make the water itself unsuitable for use.

In irrigation, it may make the irrigating water dangerous to public health, and silt up dams and canals.

In navigation, it chokes channels and damages navigation structures, shipping, and water-front buildings.

In production of hydroelectric power, it damages turbines and other equipment and reduces capacity. It greatly shortens the life of condensers in steam plants. It shortens the life of all storage reservoirs, whatever their purpose.

Pollution Abatement and Multiple Use

In the development of water resources in a river system through building multiple-purpose dams for flood control, power production, irrigation, public water supply, and other uses, what are some of the public health and pollutional factors to be considered?

By changing a flowing stream into an arm of a reservoir, the self-purification capacity of the stream may be altered sufficiently to aggravate pollution problems of towns and industries along the reservoir shore line. Waste discharge may be backed up into waterworks intakes. Heavy growth of algae, imparting obnoxious tastes and odors to the water, may also result. The recreational development of the reservoir area would be impaired.

Reservoir site-clearing has water quality implications that require attention. Also, when public water supply is to be developed, special safeguards have to be taken into account. Dams should be designed to allow a fluctuation in the reservoir level that will break the life cycle of the anopheles mosquito.

Reservoir water quality varies according to depth, too—physically, chemically, and biologically. This should be considered in release of the water for downstream use, including that for dilution of wastes.

The most important pollution control function of a dam is its regulation of flow for downstream dilution. Waste treatment below the dam will be based on this flow. Also, the flow will affect the classification of the stream in conformance with present and prospective uses. Knowledge of reservoir operation makes possible fullest use of the stream's self-purification capacity, reflected in lower treatment costs. These factors have not received the consideration that must be given them in planning multiple-purpose projects.

To sum up, pollution abatement measures should be considered an integral part of any water resources development planned as a comprehensive water resources program and these measures should be coordinated with the multiple-use principle as a whole. Plain common sense, as well as cost in dollars and cents, makes this essential.

Cost of Pollution

Even from the economic standpoint, the effect of pollution on public health should be accepted as the most important consideration. Aside from the cost of medical care, lost man-hours of work, and loss of lives resulting from epidemics caused either by polluted streams, lakes, or bays, or from mosquito-breeding bodies of water, there are other major social and human costs that are real costs even though intangible and largely impondерable. The direct and indirect costs of a single epidemic from contaminated water are so extensive, and its secondary effects and reactions are so ramified, that no attempt has ever been made to assess them in money.

Estimates of the additional cost of providing a pure metropolitan water supply and maintaining navigation are also impressive. For example, in the Washington, D. C., metropolitan area between $300,000 and $400,000 could be saved annually by reasonable abatement practices. This saving would be derived from lower capital and operating costs in water purification, in the removal of sediment by dredging, and maintenance costs of shore installations and navigation facilities.

In many parts of the country the rivers and streams furnish the finest natural recreation grounds available for hundreds of miles. Swimming, boating, sports fishing, camp, and resort locations are adversely affected or eliminated by pollution.

These natural recreation grounds not only give people living nearby the chance to enjoy a pleasant evening or perhaps a Saturday or Sunday in beneficial relaxation, while their children have fun in natural and healthful surroundings, but they have considerable economic importance. They are closely associated with the vacation-travel business. Water pollution may result in complete suspension of this industry along the affected areas, with heavy financial losses to the community, and to those people engaged in catering to tourists.

If these are multiplied to arrive at an estimate of damage from pollution in the Nation's large river valleys, the amount would be staggering. Combined with other damages it can safely be placed in the tens of millions, going a long way in balancing the estimated cost of cleansing the country's waterways at present prices.

Obstacles to Progress

From what has been said, it follows that development of our water resources requires a close consideration of pollution and pollution abatement possibilities from every angle—economic, social, physical. The geographic river basin offers the most natural area for such coordinated attack.

struction of domestic and industrial waste-treatment plants, together with improvement in farming and ranching practices, can proceed while the basic data are being gathered. Such progress has been too slow.

Building a sewage-treatment plant lacks appeal for taxpayers who may not as yet be entirely convinced of the need. The contemplated cost poses a difficult financial problem for many small towns and cities that may have reached their statutory borrowing limit. In still other communities, this construction has to compete with the need for streets, schools, or other projects such as stadiums, that have greater appeal for the taxpayer who must foot the bill.

In the field of industrial waste, the construction of waste-treatment plants by factories adds to the cost of capital investment and overhead, increasing the chance of a red balance sheet. Certain firms may lack the reserve capital for such construction.

Another major deterrent to pollution control is the interstate character of many streams and other bodies of water, combined with the lack of uniformity in State laws.

Private industry is competitive. An industry will hesitate to spend a substantial sum on waste treatment works that may give a competitor the advantage of lower production costs—unless the competitor also builds a treatment plant.

A similar consideration may influence States and cities eager for industry to locate in their area or, for that matter, to remain in the locality. States are reluctant to adopt antipollution laws more stringent than those in neighboring States for fear of driving away industry. Cities, especially smaller ones that depend almost entirely on local industry for their prosperity, are even more aware of the possible consequences of insisting on industrial waste treatment.

When the 1948 law was being considered by Congress, the Senate Public Works Committee declared that "unless the very reasonable enforcement procedures provided for in the bill bring about the needed results, it is reasonable to anticipate that a later Congress will enact very much more stringent enforcement legislation."

Federal Authority Under the 1948 Statute

The Water Pollution Control Act of 1948 declares it a congressional policy to recognize the primary responsibilities and rights of the States in controlling water pollution. But a program of financial assistance by the Federal Government is also provided. For the period 1948–53, the act authorizes the appropriation of $22,500,000 annually for loans to any State, municipality, or interstate agency for the construction of necessary sewage treatment works.

Also authorized is the appropriation of a million dollars a year to be paid to States for conducting investigations, research, surveys, and studies related to the prevention and control of water pollution caused by industrial wastes. Another authorized appropriation of a million dollars a year is for grants to States, municipalities, or interstate agencies to aid in financing the cost of engineering, architectural, and economic investigations and other action preliminary to the construction of projects approved by the appropriate State water pollution agency and by the Surgeon General.

Under the Statute the Federal Government has no original enforcement powers other than that of holding public hearings on individual pollution violations.

If the pollution should continue after a reasonable opportunity to comply with recommendations resulting from the public hearings, the Federal Security Administrator may, but only with the consent of the water pollution agency of the State where the pollution occurs, request the Attorney General of the United States to bring suit to secure abatement.

By and large the ultimate solution of the Nation's pollution problem will be governed by public support for effective action. Further research is required on industrial waste treatment methods and dissemination of that knowledge throughout industry. The facts on pollution should be made far more widely known to the general public. These include not only the negative aspects of the problem, but possible posi-

tive benefits—the use of sludge as a byproduct, for example, and the reuse of sewage effluent.

A Task Committee In Search of Byproducts

Industrial research and dissemination of technological information are the objectives of the National Technical Task Committee on Industrial Wastes sponsored by the Public Health Service and made up of industrial, State, and Federal Government representatives. This committee will endeavor to assemble information on industrial waste processes, practices, research projects, and problems for which no solution is known, and make this information available to industry.

The committee has four major task groups: food industries (canning, dairy, corn, fermentation, distillers, beet sugar, and meat); mineral products (iron and steel, nonferrous metals, coal and other mining, petroleum, byproduct coke and gas); chemical processing (chemical, textile, pulp, paper and paperboard, tanning, rubber, and electric-plating); and general industry (automotive, electrical equipment). Other industries such as railroads, lumber, paint and varnish, and power are expected to participate in this coordinated government-industry attack on the industrial waste problem.

The manufacturing activities that now contribute the larger share of pollution to our waterways are foods, beverages, textiles, leather, chemicals, petroleum, gas, iron and steel, nonferrous metals, rubber, paper, and mining, including coal and oil-well drilling. Nearly all these are already represented on the National Technical Task Committee.

Although industrial waste utilization in the form of byproducts is not the normal expectation in manufacturing, especially in smaller concerns, individual examples of waste recovery and consequent pollution reduction hold greatest hope for assisting in solving the industrial pollution problem. Some examples are striking.

A chemical company ordered by a State health department to abate its pollution studied its waste and discovered a high vitamin content which it began to extract. Today the vitamins are the company's main product.

A steel company in the Ohio Valley, after building a treatment plant at a cost of $516,000 to recover ore from blast furnace flue dust that was being dumped into the river, found that treatment was not only paying for its operation, but made a profit of $581,000 in the first year of operation.

A division of a large automobile corporation is skimming the oil from waste collection tanks and selling it to a local concern that purifies and packages it for consumers. The corporation's return equals the cost of recovery.

The distillery industry for years has extracted dried grains and protein concentrates for sale as cattle food.

A steel company in New Jersey gives its pickle liquor to a local firm that uses it to make iron sponge for gas purifiers.

A chemical company in Texas formerly dumping 100,000 tons of aluminum chloride annually now salvages more than half for sale to a paper mill as a substitute for alum.

Another company is making high-grade molasses from citrus peel liquid discharge.

In general, the recovery of industrial waste material as a byproduct has a record of a moderate return on the operation rather than big profits. Nor is byproduct recovery of waste material an extensive practice in industry. Research by industry and university staffs stimulated by funds in the Pollution Control Act of 1948 and by the National Technical Task Committee is expected to improve the situation.

From Sewage to Fertilizer

So far as byproduct recovery is concerned, private industry's record is superior to that of muncipalities. Only a few cities—Chicago, Milwaukee, Grand Rapids, Toledo, and Pasadena, for instance—recover and sell their sewage sludge as fertilizer. Other cities pay for its removal or incineration. More than 18 million tons of sludge are destroyed annually, and (based on the $2-a-ton removal rate paid in the Nation's Capital) at

least $36 million is paid for its removal. If packaged and sold instead of being dumped or burned, this sludge would gross nearly $400 million a year, net a profit to the cities, and return a valuable fertilizer to the soil. Some farmers are aware of the value of sludge and are using more of it every year. Their number is increasing.

Actual tests of sludge as a fertilizer have demonstrated that heavy applications can make nearly worthless farmland produce normal crops in two or three years. Sludge usually contains all elements needed for plant growth, and also consists of about 40 percent humus. The organic nitrogen content varies from 1½ to 6 percent depending on the sludge and processing. This compares favorably with the 4 percent of organic nitrogen in cow manure.

Sewage effluent can also be profitably recovered but only two or three cities have taken advantage of this. Baltimore, Md., has contracted to furnish 100 million gallons daily to Bethlehem Steel Co. as cooling water, an outstanding example of such re-use.

In broadest perspective, pollution abatement and cleansing our Nation's waters is a battle against waste—the waste of water, of sludge and sewage effluent, of valuable organic material and minerals in industrial process, and of valuable topsoil from farm and grazing land.

Health considerations, of course, must outweigh all others in the effort to reduce this waste. Even though the opportunities for profitable recovery may stimulate construction of treatment plants, the national welfare must be governed by a higher motive than that of profit.

Need for Action

Grave as it now is, the pollution problem is bound to deepen as population and industry grow. This need not be. The losses and injuries we now sustain are by no means irretrievable if we act now.

The sharpest issue that arose during debate on the present act was whether to give the Federal enforcement agency authority, where pollution in one State affects another State, to compel abatement of such pollution without the consent of the State in which such pollution arises, or to authorize such enforcement only with the consent of the latter State. The decision of Congress was to require such State consent.

The Senate committee, reporting the bill, indicated clearly, however, that if this approach to enforcement failed, Congress would reconsider the question of direct Federal action without consent.

There is a growing feeling among the States and industry favoring improvement of the pollution situation. In response to this feeling the Public Health Service is taking the lead in bringing about consideration by all concerned of a model State water pollution control law, which it is hoped will improve State enforcement.

The Commission has examined the whole situation and agrees with the Senate committee that, if the 1948 act fails to produce progress in pollution abatement which will achieve the objective of clean rivers within a reasonable period of years, steps toward direct Federal enforcement will be required.

The value of a clean river includes in some part an ageless heritage of quiet and natural beauty, a priceless possession that we must pass on to succeeding generations uncorrupted or restored. We all know this feeling. In all of us there is an inborn urge to seek the edge of the water, even if only to walk along it, or to drive in a car where we can see it and be in some measure rested and renewed. The attraction of water is universal, and so is an instinctive sense of offense when a beautiful body of water is desecrated and despoiled. Polluted streams, littered with trash and banked with refuse heaps that smell to heaven, blight not only the water itself and the valley, but blight our own joy and confidence in living. These waters that we have ourselves befouled make us turn our backs in shame. It is not enough to build costly artificial means of recreation. Concrete swimming pools pumped full of chlorinated water are not enough.

True, the streams and ponds, the pools and lakes, the great rivers and the oceansides of America can probably not be returned in their entirety to their original natural beauty. But by

measures now known, and other measures to be discovered, we can redeem our water resources.

RECOMMENDATIONS

On the basis of the foregoing analysis of the pollution control situation, the Commission recommends that:

1. The effectiveness of the 1948 Water Pollution Control Act, with its dependence on local-State-Federal cooperation to bring pollution under control, should be thoroughly tested. To assure this test Congress should increase the present inadequate appropriations for the effective discharge by the Public Health Service of its functions under the act and for loans to municipalities and others to enable them to construct the necessary sewage and waste treatment facilities.

2. Such provision should include (*a*) appropriations for the administrative and regulatory activities of the Public Health Service, Division of Water Pollution Control, sufficient to make possible adequate staffs in each river basin for the necessary surveys, case preparations, and regulatory actions; and (*b*) funds for Federal loans to municipalities, other public bodies, and industries, at not more than 2 percent interest, covering the entire amounts required to construct sewage and waste-treatment works.

3. Funds for such loans should be allotted on the basis of pollution control programs developed as integral parts of comprehensive river basin programs by the responsible Federal agency in cooperation with other Federal agencies, the States, municipalities, and industries concerned. Such allotments should be made on the basis of need.

4. Plans for construction of waste treatment plants, whether municipal or industrial, should include reasonable provision for (*a*) making organic materials in waste available for use, (*b*) utilizing byproduct gas, (*c*) reclaiming valuable minerals, and (*d*) processing the discharged water for reuse by industry or recharging ground water.

5. Pollution control, where it is a problem, should be an integral part of comprehensive river basin programs, with full consideration given to this objective from the beginning of the planning process. So far as consistent with the best overall use of the resources of the basin, reservoirs should be planned so as to (*a*) avoid aggravation of pollution problems of upstream communities, (*b*) permit fluctuation of the reservoir level to stop propagation of disease-carrying mosquitoes, (*c*) regulate releases of water to make the fullest use of the stream's potential self-purification capacity, with releases scheduled beforehand to permit proper classification of the stream for pollution control purposes.

6. If this Federal-State-local cooperative pollution control program fails to provide the country with clean rivers within a period of 10 years, the 1948 act should be reconsidered with a view to providing for Federal enforcement, without the requirement of State consent, where polluted streams are within the jurisdiction of Congress.

Chapter 12

Domestic and Industrial Water Supply

ADEQUATE DOMESTIC and industrial water supplies are essential to the health and welfare of our people. Sixty percent of the population of the Nation lives in cities. Any plan for the conservation and development of the water and land resources of the Nation must, of necessity, take into consideration the water requirements of these urban people and of industries. Plans for control and development of water resources should no longer be made by single groups, whether they be local, State, or Federal. They must plan together irrespective of how construction and operation are arranged for and handled.

The domestic and industrial water supply of all cities and communities, whether it be surface or underground, has its origin in rainfall and runoff on land and water surfaces in whole or in major part from outside the areas of such cities and communities. If all of the water that falls as rain or snow within the boundaries of these urban areas could be captured and held—an impracticable proposal—it would not be sufficient for the needs of the people and the industries in those areas. Their necessary water supplies are affected by forest and range, by farming operations, diversions of water, by sewage, and by wastes from other cities, communities, and from industries. These effects may relate to the quantity of water available at flood flow, average flow, and low flow; and they have a special bearing upon the quality of raw water.

In earlier development of cities, when most of the population of the Nation was rural and our cities were small and had little industry, there was relatively little competition for available water supplies except in the arid and semiarid West. With the rapid growth of cities, spurred by accelerated industrial development, the complexity of water and land use posed additional problems of conservation and distribution. The formation of great metropolitan areas and grouping of communities have not only accentuated the dependence of many communities upon already exploited water supplies, but have repeatedly forced a search for new sources.

Industries may be served by water from the city water department or utility or they may develop their own water supply from surface or ground water sources. About 25 percent of water for industrial use is purchased, while 75 percent of the water needs of industry is developed by industrial plants largely from ground water sources.

Some urban areas and cities are already receiving benefits to their water supplies through Federal multiple-purpose water developments. First and most noteworthy in this list is the service rendered in that respect by the Hoover Dam on the Colorado River, which was constructed by the Bureau of Reclamation through the provisions of the Boulder Canyon Project Act of 1928. Twenty-eight communities with a population of over 3,500,000 are dependent, in whole or in part, upon the Colorado River aqueduct of the Metropolitan Water District of Southern California, made possible by construction of the Hoover Dam.

How Waterworks Grew

Beginning with Boston in the year 1652, the number of waterworks had grown to 17 by 1800; 4,000 by 1900, and 15,400 by 1945.[1] This growth is even more accelerated than urbanization (cities over 2,500 population) in the United States, which was 5.1 percent in 1790; 39.7 percent in 1900, and 56.5 percent in 1940. At the present time, 30 million people, 20 percent of the population, live in 5 metropolitan areas having a central city of more than 1 million population. Twenty-six percent live in the 10 largest metropolitan areas. On the other hand, almost 80 percent of public water supplies are in communities of 2,500 population or less.

Waterworks are in general local enterprises, of which 80 percent are publicly owned and 20 percent privately owned. This is the reverse of the situation 100 years ago.

During the past 30 years, there has been a distinct tendency for the remaining privately owned waterworks to consolidate into larger companies operating in many separate communities. Only a few of these water companies operate interconnected water systems such as have grown up under public ownership through the formation of metropolitan water districts to serve several separate communities from one interconnected system.

Table 1, Number and Population of Cities Obtaining Water from Surface and Ground Water, shows that the greater number of cities obtain their supplies from ground water, but the greater population secures its supply from surface sources.

TABLE 1.—Number and population of cities obtaining water from surface and ground water

Population (thousands)	Number of cities	Ground water	Number of cities	Surface
Over 100	22	3,035,455	144	30,382,555
50 to 100	20	1,481,810	61	4,880,250
25 to 50	67	2,406,860	115	4,594,185
10 to 25	268	3,953,690	284	4,709,865
5 to 10	643	3,581,070	323	2,569,715
1 to 5	3,526	6,995,830	1,193	3,581,315
Total	4,446	21,504,715	2,120	50,717,585

SOURCE: U. S. Public Health Service, 1950.

[1] U. S. Public Health Service Survey in 1945 recorded a total of 15,400 water systems which served 94,300,000 persons living in population groups of more than 200.

The Low Cost of Urban Water

Administration of waterworks in most cities is an integral part of city government, and such systems pay their revenues into the general fund and operate on annual appropriations. Although this condition is generally confined to the smaller communities, it still exists in such large cities as New York and Philadelphia. A growing number of cities provide for the operation of their waterworks as public utilities under appointive boards and with funds kept separate from the general funds. Such is the situation in the Los Angeles Department of Water and Power. By recent authority to issue revenue bonds for construction, many such communities may construct needed additions to plant facilities without relation to limitation upon issuance of bonds secured by the real property of the community. Utility operation, under this plan, tends toward better management and sounder financing of the waterworks.

The historic cost of waterworks averages about $60 a person, but in cities importing their water great distances the cost may be twice as much. Costs have increased in recent years so that the present average for new construction is probably $100 to $125 for each person served in cities having local water supplies.

In spite of these increasing costs, water is one of the least expensive essential commodities that the public buys. Annual domestic water charges in the United States average only $6 a person, or less than 2 cents a day. In general, domestic water is procured, filtered, pumped, and distributed at the small cost of less than 5 cents a ton.

On the basis of such low costs there should be no American community that cannot afford an adequate domestic water supply. These figures also indicate that water can be sold at prices which should enable any domestic and industrial water supply features of multiple-purpose projects to be

completely self-liquidating through payments by the communities benefited.

A major function of waterworks is to provide adequate quantities of water at adequate rates of flow for fire protection. While the capital cost of providing for fire protection may represent 25 to 40 percent of the cost of the waterworks, the quantity of water used annually for fire purposes is relatively small. In larger systems, it is an insignificant part of total annual requirements.

Increasing Requirements

The per capita use of water distributed by waterworks is slowly increasing. By 1945, the Public Health Service reported an average in the United States of 127 gallons per capita a day, varying from 60 gallons in communities of 500 population to 140 or 150 gallons in cities of 10,000 and over. Growing commercial and industrial activity, lawn sprinkling and semi-agricultural uses, air conditioning, and generally higher standards of living and cleanliness explain, in large part, the increase in use.

Higher than average per capita use, taken alone, is not always proof of wasteful use or excessive leakage. Some cities use as much as 300 to 500 gallons per capita a day without waste, due to special conditions such as large estates or greater manufacturing activity. Use in unmetered cities may be much greater, due to waste and inadequate controls. In general, waterworks which account for more than 90 percent of production through metered sales to consumers reflect good construction and efficient operation.

According to estimates by the Geological Survey the following water uses account for 14 percent of the Nation's yearly runoff to the oceans:

	From ground water	*From streams and lakes*	*Total*
Irrigation	15	80	95
Industrial	5	65	70
Municipal	3	9	12
Rural (other than irrigation)	2	1	3
Total	25	155	180

These figures represent gross withdrawals at sources; net consumptive use is very much less. Domestic use accounts for only about 1 percent of runoff of our rivers.

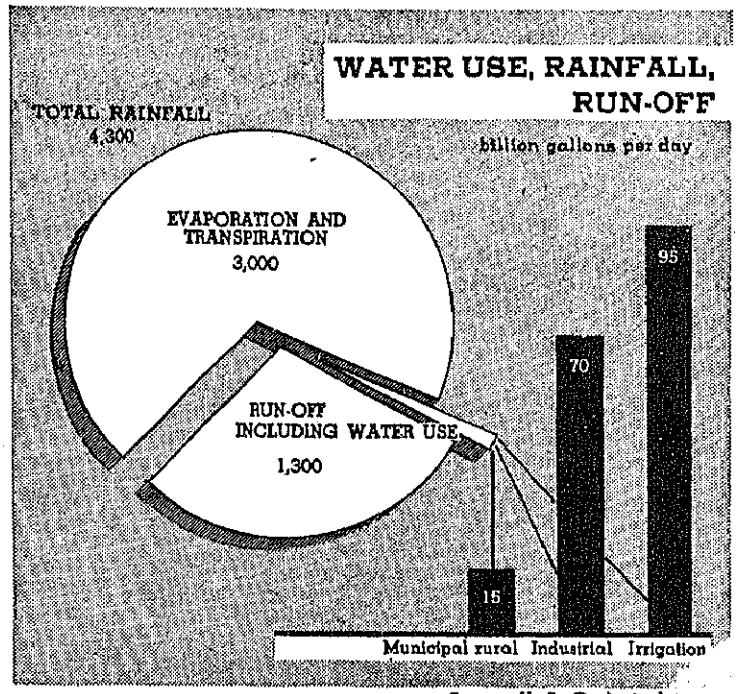

FIGURE 11.

The estimate of 70 billion gallons per day by the United States Geological Survey for industrial uses includes water used for cooling purposes. It is 7 times as high as the 10 billion gallons industry itself estimates it uses.

These high and low figures can be reconciled only on the basis that the Geological Survey figures include great quantities of cooling water which is returned to the river at higher temperature but essentially unchanged in quantity. By far the greatest consumptive use of water is for irrigation, 95 billion gpd, followed by municipal and industrial uses which are about 10 billion gpd each, and nonconsumptive water for cooling and condenser purposes. This latter requirement sometimes is as great as 700 million gpd at a single steam electric generating plant and in the aggregate is several times the water requirement for municipal and industrial consumptive uses. Cities and industries located at sea level use large quantities of sea water regularly for cooling and condensing purposes, and in some cases for wash water. Such uses of sea water may well be further extended.

TABLE 2.—Estimated industrial water use by major water-using industries, 1947

Industry	Number of establishments	Value added by manufacture $1,000 units	Production		1947 water use (estimated)	
			Amount	Unit	Gallons per unit	Million gallons
Steel (finished)	419	2,659,250	61,857,241	Ton	65,000	4,020,721
Oil refining	437	1,494,474	1,887,890,000	Barrel	770	1,452,675
Gasoline		(1)	791,325,000	do	357	791,325
Wood pulp:						
Sulfate		(1)	5,356,710	Ton	64,000	342,829
Sulfite		(1)	2,795,960	do	60,000	167,758
Soda		(1)	491,580	do	85,000	41,784
Ground wood		(1)	2,049,814	do	5,000	10,249
Total	226	415,038		Ton		562,620
Paper		(1)	10,646,833	Ton	39,000	415,226
Paper board		(1)	9,186,810	do	15,000	137,802
Total	665	1,050,108	19,833,643	Ton		553,028
Coke	167	(1)	79,146,000	do	3,600	284,493
Beer	440	808,946	88,027,000	Barrel	470	41,373
Whiskey	226	472,357	246,443,000	Gallon	80	21,155
Milk, cream, and butter [2]		(1)	71,440,000,000	Pound	0.11-0.25	14,286
Canning and preserving [3]	2,265	609,939	391,546,000	Case	7.5-250	[4] 8,520
Manufactured ice [5]	3,423	226,584	36,100,000	Ton	243.85	8,802
Soft drinks	5,618	421,000	927,700,000	Case	2.5	6,250
Woolens and worsted fabrics	495	599,534	404,563,000	Pound	70	3,252
Wool scouring	74	54,166	210,172,000	do	1.26	2,648
Tanning	561	403,783	238,731,000	do	8	1,910
Soap	249	450,721	4,138,001,000	do	0.25	1,034
Meat packing (hogs)	2,153	(1)	51,678,047	Hogshead	11	568
Cane sugar [6]	25	98,112	368,000	Ton	1,000	368
Rayon (all types)	38	447,900	746,900,000	Pound	0.16	110

[1] Value added by manufacture is not given on same basis as production and water consumption.

[2] Based on United States Department of Agriculture figures for creamery butter, liquid milk, and cream sold in communities. No other milk products subject to water consumption estimates.

[3] Excluding fish.

[4] Includes only water used in processing 14 fruits and vegetables for which consumption factors are available. This accounts for 177,321,000 cases. Total water used by this group is probably two or three times as high.

[5] Includes filling cans and pulling cores.

[6] Includes refining only.

SOURCE: Sheppard T. Powell and Hilary E. Bacon, August 1950, Journal of the American Waterworks Association.

Table 2, Estimated Industrial Water Use by Major Water Using Industries, 1947, indicates the large use of water that is required in the manufacture of certain products. These requirements do not in any way indicate the quantity of water that is consumed. Most of this water returns to the rivers after use as cooling water, or as sewage, or industrial waste. Food canning, which probably leaves the greatest percentage of water used leaves less than 6 percent of roduct.

es indicate that in certain of water required for each y manufacture is fairly well ıot represent the quantity of water consumed, a much smaller figure which is not known. Eleven such industry groups are:

Industry:	*Gallons of water per $1 of value added by manufacture*
Steel	1400
Paper pulp	1952
Oil refining	973
Paper and board	527
Beer	51
Wool scouring	49
Whiskey	45
Soft drinks	15
Woolen and worsted fabrics	5.4
Tanning	4.7
Rayon	3.6

SOURCE: Sheppard T. Powell and Hilary E. Bacon, Journal of the American Waterworks Association, August 1950.

Wherever water demand exceeds 500 gallons per dollar of value added by manufacture, the installation and operation costs for water supply become a substantial element in the over-all costs. Water quality, of minor importance in some industries, is a primary factor in brewing, distilling, soft drink manufacture, synthetic fiber, production, biological and pharmaceutical manufacture, and food processing.

In order to secure water of uniform quality and temperature, many industries use ground water. Serious problems have developed in areas where a number of industries with high water requirements have clustered in a compact area and have overdrawn the ground water. This has led to special studies of ground water resources, recharging, control of drilling, and other conservation measures that need continuing attention.

The Geological Survey has made a significant contribution to industry and to urban communities in connection with these ground water explorations. Some of the States have expanded their facilities for this purpose, among them Ohio, where the pumpage of ground water by industries greatly exceeds that pumped by municipalities. Over a 4-year period data were gathered from every known industrial and commercial establishment in the State where private ground water supplies had been developed. Records were made of the amount of water pumped, its use, pumping rates, depth and kind of wells, static levels, and logs of formations. Pumpage inventories are kept current. Universal application of this procedure should go far to warn of ground water crises in the future. Industry too frequently and for too long a period has taken water for granted.

Is Sea Water Usable?

Much has been said and written about the necessity for converting sea water into fresh water in order to relieve surface water and ground water shortages. There can be no question that fresh water can be produced from sea water. It has been done for years by ships at sea, on remote islands, and during World War II to provide water supply for troops. In its present state of development it is a high-cost method of securing potable water, many times higher than present municipal water costs and wasteful of the Nation's energy resources. This need not interfere in any way, however, with the wider use of sea water along our coasts by industries for cooling and other purposes.

Inspection of figure 11 indicates that domestic and industrial water supply use only a small percentage of the Nation's available water supply. When need arises, large quantities of water may be conveyed long distances at relatively low unit costs. Water is brought to Los Angeles more than 300 miles from the Sierra Nevada Mountains to the north and from the Colorado River more than 300 miles to the east. The problems of water supply for our large cities and groups of cities can be met by long aqueducts at a fraction of the cost of distilling sea water.

Purification and Contamination

All natural waters contain some mineral and organic matter in suspension or in solution. While it is true that water purification processes are available to treat most natural waters and make them safe and satisfactory for domestic and industrial use, the cost of such treatment may become burdensome.

Waterworks operators, therefore, are interested in all of the factors of watershed protection, land management, storage river maintenance, and best practical pollution control of both surface and ground water. Communities and industries which treat water before using it pour their wastes into streams, adding to the problems of other water users downstream. When these phases of contamination are better understood by our people, we may look forward to closer community cooperation in their elimination.

If clean rivers are maintained as proper habitats for fish and wildlife and for recreational use, then, in most cases, the water may readily be treated for domestic and industrial purposes. It should be pointed out, however, that a uniform

and stable water quality is much to be desired. When flood control and other storages are built on rivers and streams, they do not always aid in protection of water quality. In fact, such reservoirs may produce large quantities of objectionable algae, or alter river temperatures. Also, outlets are often at great depth, which may make the dissolved oxygen content of the released water so low as to damage fish and wildlife and make the water generally objectionable for long distances downstream. The elevation of rivers and streams may be seriously affected, thereby putting all diverters of water to unnecessary additional expense.

The United States Public Health Service, through its quality requirements for drinking water supplied by public carriers in interstate commerce, has established standards of water quality. As part of this program to protect the public utilizing the services of interstate carriers it has published standard methods of water analysis. These standards have been accepted and adopted by all State boards of health, and all waterworks are required to comply with them.

The Need for Nation-Wide Reports

The 15,400 waterworks, 80 percent municipally owned, do not report their operation to any single agency. This is unfortunate. The Federal Power Commission collects from all electric and gas utilities, both publicly and privately owned, a large amount of statistical data permitting comparisons of the rates and relative operating efficiencies of these essentially noncompetitive utilities.

The annual statistical and financial publications of the Federal Power Commission are of great value to the utilities themselves in checking the reasonableness of their costs, and in examining relative desirability of locations for new industrial and commercial establishments. They are, therefore, also of much assistance and value to the military establishment in times of national emergency in the selection of plant sites and awarding contracts for materials and equipment.

During World War II there were a number of instances where industrial plants, military cantonments, and other installations requiring large and dependable water supplies, were located where available water supplies later were discovered to be inadequate. In some instances catastrophe was avoided only by the good fortune of high rainfall years; drought conditions might just as likely have occurred.

It is essential that all waterworks utilities, both publicly and privately owned, be required to report, on a uniform accounting and statistical basis,

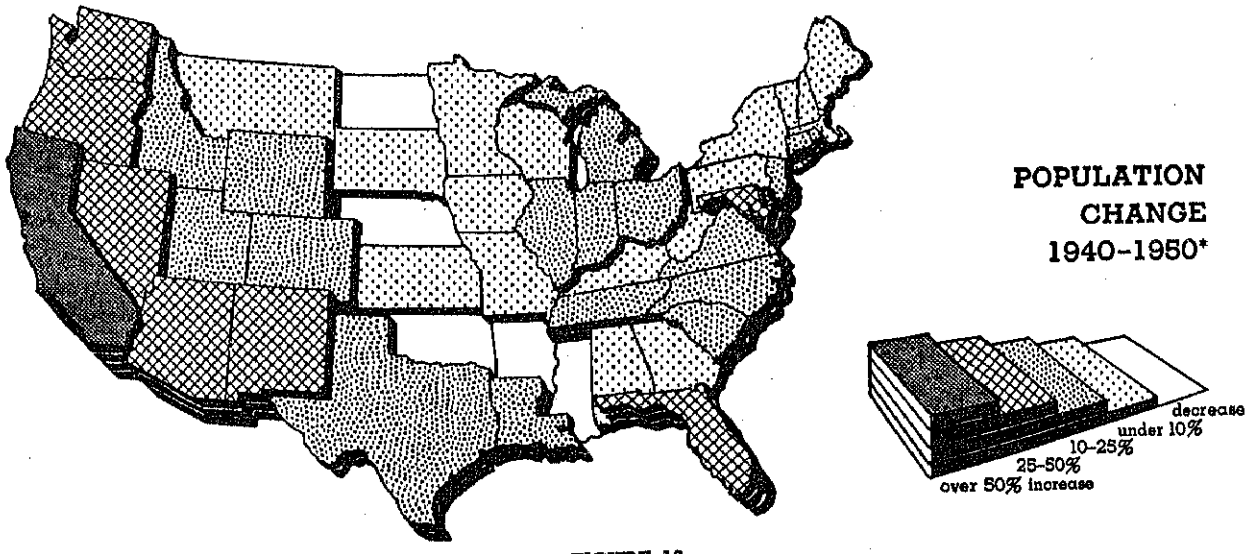

FIGURE 12.

Source: U. S. Census 1950

*Preliminary

all fundamental financial and statistical data which can be compiled in one office and made available to all waterworks managements and to other interested agencies and persons.

If all waterworks managements were required to report their finances and statistics to their respective State boards of health, on standard forms under uniform classification of accounts and statistical information, the State boards of health could then transmit this information to the United States Public Health Service for compilation and publication. This would be in harmony with the cooperative arrangement already existing in the relationship between the Public Health Service and the State boards of health.

Metropolitan Water Districts

Fundamentally the typical waterworks serves only one community, but a number of metropolitan water districts have been established to provide more adequate and economic water service either at wholesale or at retail to a number of neighboring cities and adjacent areas. These metropolitan communities are growing faster than the national population and areas outside the central city are growing faster than the central city.

The Massachusetts Metropolitan Water District, for example, was created by the State legislature in 1895 to construct and operate works to supply Boston and cities and towns within a specified distance from the State House (Boston). The district furnishes water at wholesale to 23 member cities and towns with a 1950 estimated population of 1.67 million. Water sold in 1949 averaged 190.92 million gallons a day or 113.7 gallons a day per capita. The investment approximated 100 million dollars. The district is authorized to control water waste and to approve minimum rates to be charged for water by any customer town, and to prevent diversion of water revenues to other public purposes until specified costs have been met.

The Massachusetts Metropolitan Water District—its works and its operations—represents a conspicuously successful method of meeting the water-supply needs of a densely populated metropolitan area overriding the municipal boundaries, and establishing authority to develop and sell water at wholesale.

The North Jersey District Water Supply Commission has approached the problem of regional water supply in a different manner, owing to the essential difference in State constitutional provisions of New Jersey compared to those of Massachusetts. While Massachusetts has reserved the right to legislate upon items of local concern, New Jersey has given extensive home-rule powers to incorporated communities. The

State of New Jersey is limited by its constitution to a debt of not more than 1 percent of the total amount appropriated by the general appropriation law for that fiscal year. This placed a limit, in 1950, of $1,500,000 upon the total State debt.

When water supply conditions became serious in the northern industrial part of New Jersey, the State legislature authorized the formation of public water districts. The North Jersey District, formed of eight municipalities—Newark, Paterson, Passaic, Clifton, Kearney, Montclair, Bloomfield, and Glen Ridge—had constructed works up to 1950 in the approximate cost of 31 million dollars. Each city meets its share of the debt obligations. Twenty municipalities receive all or part of their supply from the District's Wanaque Reservoir and related supply lines and pumping stations. The Hackensack Water Company, a private utility, serves 56 separately incorporated communities, of which 53 are in northern New Jersey, and three in lower New York.

The State of Pennsylvania, in 1935, adopted an authority act. By 1950, 71 waterworks had made use of this act, which permits the citizens of a single city or town or a group of such incorporated or unincorporated areas to operate as self-liquidating utilities without financial obligation to the preexisting units of Government. Such authorities may file liens for debts owed, and they have limited powers of eminent domain. They may issue revenue bonds but may not obligate municipalities. The act provides that life of an authority is limited to 50 years, and bond issues may not exceed 40 years. Authorities may engage in multiple-purpose activities and they have the power to assess benefited properties for the costs of improvements in proportion to the benefits received. The population of com-

Washington, D. C., not only serves water to this rapidly growing area but also builds and operates sewers and sewage treatment works and collects and disposes of garbage. The 1918 act of the Maryland Legislature, by which it was established, has been modified from time to time as experience has dictated. In 1947, this sanitary district served an area of 95 square miles having a population of more than 200,000. The assets of the district are in excess of 29 million dollars.

In California many water district, metropolitan, and authority acts have been passed from time to time by the State legislature. While these acts are general in character, they have been passed usually to fit the specific conditions under which a group of communities has sought to associate themselves in the procurement of an adequate water supply.

The East Bay Municipality Utility District serving Oakland, Berkeley, and a large number of cities adjacent to San Francisco Bay, brings water from the Mokelumne River in the Sierras, a distance of more than 100 miles. It also constructs and operates sewage disposal plants and can enter any public utility field. The San Diego County Water Authority is organized to distribute water received from the Metropolitan Water District of Southern California, of which it is a part.

The Metropolitan Water District of Southern California, organized under an act passed by the State legislature in 1928, was created to bring water from the Colorado River, a distance of more than 300 miles and with pump lift in excess of 1,600 feet, to supply Los Angeles and other cities and communities in the 2,500 square mile area along the 150-mile coast line from Los Angeles and Santa Monica to San Diego. This project is of special interest as it was made possible by the Colorado River Compact of 1922 entered into by the seven Colorado River Basin States, and the construction of the Hoover Dam and power plant, authorized by the Boulder Canyon Project Act, enacted by Congress in 1928. It was only as a result of the regulation of the Colorado River and the development of large quantities of low-cost hydro power by the Hoover Dam that the domestic water supply project was

made possible and economically feasible to the coastal cities of southern California.

The Metropolitan Water District of Southern California, originally including 13 cities, now includes 28 cities within its borders. It differs from most metropolitan districts in that the constituent cities and sub-water district areas need not be contiguous. Each area that associates itself with the district is represented by one or more directors appointed by the member community in proportion to the assessed valuation and having votes in block also in proportion to assessed valuation, except that no city may have more than a 50 percent vote.

Other large cities such as New York, Chicago, Detroit, and San Francisco sell substantial quantities of water to areas outside their corporate limits and thus are performing some of the services which are metropolitan in character.

The Interstate Commission on the Delaware River, commonly referred to as Incodel, is an interstate agency which until recently functioned in limited fashion under reciprocal State legislation enacted by New York, New Jersey, Pennsylvania, and Delaware. A few months ago the Commission released an engineering plan designed to provide additions to the available water supply by storage and diversion works on the

Federal-State-Local Relations

It has been pointed out earlier that the great majority of our cities, towns, and communities are served by municipal water systems. Many of them have taken advantage of enabling legislation providing for metropolitan districts or authorities to work together to obtain needed water supplies more economically than they could have done separately. About 20 percent of the communities are served by private water companies and in some instances such companies have afforded a means of unified water development and interconnection for a number of communities in a local area. Some States administer water rights and supervise the construction of dams. In general the operations and rates of privately owned waterworks are subject to a State commission. In some States these commissions establish uniform systems of accounts affecting publicly owned waterworks, and in at least one State (Wisconsin) the commission has jurisdiction over rates charged

le information to waterworks management. dustries are using these services on an increas- g scale, especially in their search for reliable ound water supplies. The extensive investiga- ons and construction of projects by the Depart- ent of the Army and the Bureau of Reclamation so involve the local waterworks.

There is a pressing need for improved coopera- on in the planning of river and drainage basin udies which necessarily involve municipal water upplies, and in many cases the actual works of unicipal and industrial water systems. The ontinuing expansion of urban population and ndustry will require expanding volumes of water, vith particular attention to water quality. Planning for the development of river systems nd drainage basins for the best multiple-purpose se should, in the broad public interest, take into consideration all problems of industrial and do- nestic water supply which directly involve the great majority of the people of the Nation.

The service of domestic and industrial water supply has been, and should continue to be, primarily a local responsibility. With increasing populations and concentrations of industry, however, there has developed a greater need for cooperation of neighboring communities in the formation of metropolitan water districts. It seems clear that such districts will continue to develop, probably at an accelerated pace.

Whether the Federal-local cooperation in multiple-purpose water projects relates to large or small populations, it is believed that local government is fully able to meet all costs of municipal water supply developed either independently or as a part of Federal multiple-purpose river developments.

RECOMMENDATIONS

1. The use of water for domestic purposes should be considered the highest and most universal use by man.

2. Domestic and industrial water supply should continue to be a matter of local concern, and comprehensive river basin planning should take this into account. The cost of obtaining water supplies for domestic and industrial purposes should be borne by the local communities and industries served.

3. The States and the Federal Government should encourage the formation of metropolitan water districts to develop and transmit necessary water to meet in the most economical way the requirements of a group of communities when those communities are dependent upon the same source of water supply or when existing water supplies prove inadequate.

4. In planning for multiple use of water in a river basin, the river basin commission should give adequate consideration to the importance of domestic and industrial water supply. It should work out a basis of effective cooperation of the communities concerned with water supply in the comprehensive river basin programs.

5. The Federal Government should assume leadership in assisting waterworks managements in the further protection and improvement of the quality of both raw and treated water. It should continuously collect data and report its studies and research on the long-time trends in amount and quality of water supply available.

6. The Federal Government should assume leadership in developing economical means of disposing of all forms of industrial wastes, including atomic wastes.

Excerpts from Other Chapters - - -

RECOMMENDATIONS FOR A NATIONAL WATER RESOURCES POLICY

"Pollution control should be considered in the planning and development of river basin programs. It should be recognized as a major contribution to the Nation's objectives in the fields of water supply, recreation, fish and wildlife".

"The recreation potentialities of all water resources, whether natural or artificial, should be recognized, and expansion of outdoor recreation opportunities should be given full consideration in all comprehensive basin programs. To achieve this objective suitable lands adjacent to Federal water projects should be reserved for recreation use, and consideration should be given to minimizing water level fluctuations in storage reservoirs during vacation season, to improving low flows of rivers, and to pollution abatement. In densely populated areas and in regions where natural water recreation opportunities are limited, recreation may be a controlling factor in water resources programs".

UNITY IN PLANNING

"Planning should be approached with the multiple-purpose concept and with the aid of maximum net benefits based on full consideration of alternative plans for meeting existing and anticipated needs. This means that, from the start of planning, full weight must be given to watershed management, municipal and industrial water supply, hydroelectric power, pollution abatement, fish and wildlife, and recreation, as well as to flood control, irrigation, and navigation, to the extent of their importance in the particular region. It should assure joint coordinated action of all interested Federal, State, and local agencies on an effective cooperative basis".

"Again, it seems to be quite generally believed that questions affecting the quality of water with special reference to health considerations and pollutions should be handled by (a State) agency specializing in this field".

"The authority for the preparation of basin programs should be broad enough so that full and equitable consideration may be given to flood control, irrigation, navigation, power, municipal and industrial water supply, control of pollution, fish and wildlife, recreation, and the development, use, and conservation of related land, forest, and mineral sources".

EVALUATION

"The pollution of streams destroys the value of those waters for domestic and industrial use, for fish and wildlife, for recreation and esthetic uses; it converts a resource of value into a menance to public health and an offensive public nuisance".

THE NEED FOR BASIC INFORMATION

"The facts required to understand, to control, and to make use of our water resources cover a wide range of specialized fields. . . They include population, income, employment, production, and damage from floods and droughts, as well as facts relating to agriculture, forestry, fishing and trapping, mining, manufacturing, transportation, power, water supply, pollution of streams, fish and wildlife, and recreation".

RECREATION

purposes, while streams and rivers through all densely settled regions have become open sewers which wash away the waste products or urban populations and the industries in which they work".

"No other phase of a water resources program promises so much toward expanding outdoor recreation opportunities as the cleaning up of our rivers. Pollution abatement strikes at an importance source of destroyed recreational values. Although a sewage-treatment plant is not recognized as a recreation facility, its absence definitely limits recreation possibilities downstream. Good land and watershed management are not considered recreation programs as such, yet they decrease the sediment content of rivers, enhance production of wildlife, retain water-flow patterns at optimum levels, promote fish production, and a wide variety of other downstream recreation uses.

"These programs will have the greatest impact on urban areas where the need for nearby parks and playgrounds is most pronounced. River flood plains in some densely settled areas are shunned for real estate development because of the natural flood hazard along the river banks as well as the hideous blight often found there. When the sediment loads which most rivers carry have been decreased and municipal and industrial waste discharges are satisfactorily controlled, alert communities will avail themselves of opportunities to establish, at reasonable cost, public parks and river parkways all along the riverside. Industrial properties at water fronts, if tidied up, would add interest and variety to park users.

"As pollution is abated, this major change in land use along streams should be anticipated and the land acquired for public use before prices become prohibitive. River frontage devoted to parks, picnic areas, river trails, and parkways would contribute to great improvement of the appearance of cities and their acceptability as places in which to live.

"Wise use of our land and waters is also important for recreation in more remote regions. Mine wastes, paper mill contaminants, and large quantities of silt destroy aquatic life

in many miles of streams. Both quantity and quality of fishing increase in clear water. Boating on clean rivers becomes pleasure boating. Park and picnic areas scattered along clear streams would make their natural beauty accessible to everyone".

FISH AND WILDLIFE

"When rivers, lakes, or bays are loaded with excessive quantities of sewage, sediment, or certain industrial wastes, the aquatic life of these waters is obliged to escape or die. Organisms at every level may be killed outright by toxic substances or by lack of oxygen. Aquatic plants, dependent on sunshine, will cease to grow in muddy water. Spawning beds and important bottom-dwelling life may be smothered under a blanket of silt or sewage sediment. As organic materials decay, vital dissolved oxygen is consumed. Vigorous organic decomposition or caustic pollutants may change the chemical reaction of the water to such an extent that the protective mucous membranes of fish are dissolved or the oxygenation of blood through their gills is prevented.

"Poison pollutants from industrial plants are often difficult to isolate or eliminate, but when efforts are finally successful the results in terms of fish recovery are very satisfying. It was recently found that zinc poisoning had killed many fish for 60 miles below a large rayon plant on the Shenandoah River. As a result of corrective action taken in 1948, the fish population is now increasing.

"Other encouraging signs are the recent reappearance of a few oysters within a stone's throw of the Statue of Liberty and the partial restoration of the Hudson River shad run. Both of these events suggest that the pollution abatement program in New York is beginning to make some progress.

"Plainly, a pollution abatement program is essential to the future of our wildlife resources. The abundance of wild animals and fish that might result from such a program stirs the imagination".

CONSERVATION EDUCATION

"He, (the informed citizen) and his fellow citizens have the final responsibility for allowing streams to remain putrid, for allowing careless builders to increase floods, for permitting their common ground water resources to be exhausted or polluted. Every State has the power to stop such abuses. Moreover, aroused public opinion may be as influential as a court order".

"Control of pollution from city sewage and industrial waste must be given high priority in conservation. This will be accomplished by using conservation storage to increase low stream flows and by treatment of sewage and waste before it enters the streams".

Copies of the President's Water Resources I
be obtained from the Superintendent of Docu
Washington 25, D. C., as follows:

Volume I: "A Water Policy for the Ame
No. 911609 ($3.25)
Volume II: "Ten Rivers in America's F
No. 911610 ($4.50 - estimated sales p
Volume III: "Water Resources Law,"
No. 911611 ($2.25)
"Summary of Recommendations,"
No. 917296 ($.15)